vacuubrand

Technology for vacuum systems

Instructions for use

MD 1 VARIO-SP
MD 1

Diaphragm pump

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Dear customer,

Your VACUUBRAND diaphragm pump shall support you at your work for a long time without any trouble and with full load output. Thanks to our large practical experience we attained much information how you could add to an efficient application and to personal safety. Please read these instructions for use prior to the initial start-up of your pump.
VACUUBRAND diaphragm pumps are the result of many years of experience in construction and practical operation of these pumps combined with the latest results in material and manufacturing technology.

Our quality maxim is the ”zero fault principle”:

Every delivered diaphragm pump is tested extensively including an endurance run of 18 hours. Due to this endurance run, also faults, which occur rarely, are reported an can be corrected. Every single diaphragm pump is tested on achievement of the specification after the endurance run.

Every VACUUBRAND pump leaving our factory achieves the specification. We feel obliged to this high quality standard.

We are aware that the vacuum pump should not draw a part of the real work and we hope to contribute with our products to an effective and troublefree realisation of your work.

Yours
VACUUBRAND GMBH + CO KG

After sales service: Contact your local dealer or call +49 9342 808-193.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Contents

Safety information! **4**
General information 4
Intended use 4
Setting up and installing the equipment 4
Ambient conditions 5
Operating conditions 6
Safety during operation 6
Maintenance and repair 8
Technical data **9**
Gas inlet temperatures 10
Wetted parts 10
Pump parts 10
Controlling the MD 1 VARIO-SP 13
Use and operation **15**
Installing in a vacuum system 15
During operation 16
Shutdown 17
Troubleshooting **18**
Replacing diaphragms and valves **19**
Cleaning and inspecting the pump heads 20
Replacing the diaphragm 20
Replacing the valves and assembling the pump heads 22
Assembling the connection hose 24
Notes on return to the factory **25**
Health and safety clearance form **26**

DANGER

➨ Danger! Immediate danger. Death or severe injuries as well as damage to equipment and environment can occur.

WARNING

☞ Warning! Possible danger. Severe injuries as well as damage to equipment and environment can occur.

CAUTION

• Caution! Possible danger. Slight injuries as well as damage to equipment and environment can occur.

NOTICE

Note. Disregarding of notes may cause damage to the product.

Caution! Hot surface!

Isolate equipment from mains before removing the cover.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Safety information!

General information

NOTICE

☞ **Read and comply with this manual before installing or operating the equipment.**
☞ Transport the pump at the provided handle or the recessed grips.
Remove all packing material, remove the product from its packing-box, remove the protective covers from the inlet and outlet ports and keep, inspect the equipment.
If the equipment is damaged, notify the supplier and the carrier in writing within three days; state the item number of the product together with the order number and the supplier's invoice number. Retain all packing material for inspection.
Do not use the equipment if it is damaged.
If the equipment is not used immediately, replace the protective covers. Store the equipment in suitable conditions.

Intended use

⚠WARNING

☞ The pump and all system parts must not be used on humans or animals.
☞ Prevent any part of the human body from coming into contact with vacuum.
☞ Ensure that the individual components are only connected, combined and operated according to their design and as indicated in the instructions for use.
☞ Comply with notes on correct vacuum and electrical connections, see section "Use and operation".

⚠CAUTION

- The pumps are designed for **ambient temperatures** during operation between +10°C and +40°C. Check the maximum temperatures if installing the pump in a cabinet or a housing and make sure ventilation is adequate. Install an external automatic ventilation system if necessary. If pumping hot process gases make sure that the maximum permitted gas inlet temperature, which depends on several parameters like inlet pressure or ambient temperature (see "Technical data"), is not exceeded.
- Particles and dust must not be aspirated.

NOTICE

Use the equipment **for the intended use only**, i.e. for generation of vacuum in vessels designed for that purpose.

Setting up and installing the equipment

⚠ DANGER

➨ Equipment (pumps with AC motor) must be connected only to a **suitable fused and protected electrical supply** and a suitable earth point, provide slow-blow fuse according to voltage supply (see "Technical data"). Failure to connect the motor to ground may result in deadly electrical shock.
The supply cable may be fitted with a moulded European IEC plug or a plug suitable for your local electrical supply. If the plug has been removed or has to be removed, the cable will contain wires colour coded as follows: green or green and yellow: earth; blue or white: neutral; brown or black: live.

⚠WARNING

☞ Due to the high compression ratio of the pumps, pressure at the outlet port might be generated being higher than the maximum permissible pressure compatible with the mechanical stability of the system.
☞ Do not permit any **uncontrolled pressurizing** (e. g. make sure that the exhaust pipeline cannot become blocked). If there is an exhaust isolation valve, make sure that you cannot operate the equipment with the valve closed. **Risk of bursting!**

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

☞ Always provide a free and pressureless exhaust pipeline.

⚠CAUTION

- Comply with **maximum permissible pressures** at inlet and outlet and pressure differences, see section ”Technical data”. Do not operate the pump with overpressure at the inlet.

- Check that mains voltage and current conform with the equipment (see rating plate).

- Change the setting of the voltage changeover switch (pump with dual-voltage motor 100-120 V / 200-230 V; 50/60 Hz) only if the pump is separated from mains. Check that the voltage changeover switch is set correctly. **Attention**: If the pump is switched on with wrong voltage selection, the motor might be damaged!

- Avoid overpressure of more than 0.2 bar in case inert gas is connected to the pump or to a venting valve.
- Connect pipes gas tight at inlet and outlet of the pump.
- **Attention:** Flexible elements tend to shrink when evacuated.

- Adopt suitable measures to avoid the flowing of liquids on or into the pump motor when assembling or disassembling vacuum connections at the pump. **Risk of corrosion and/or short circuit!**

NOTICE

Provide a firm level platform for the equipment and check that the system to be evacuated is mechanically stable and that all fittings are secure. Ensure a stable position of the pump without any mechanical contact except of the pump feet. Comply with all applicable safety regulations.

Keep a distance of minimum 20 cm between fan and ambient parts (e.g. housing, walls, ...). Check fan regularly for dust/dirt, clean if necessary to avoid a cutback of ventilation.

If the equipment is brought from cold environment into a room for operation, allow the equipment to warm up (pay attention to water condensation on cold surfaces).

The diameter of the inlet and outlet pipeline should be at least as large as the diameter of the pump connection pipelines.

Comply with all **applicable and relevant safety requirements** (regulations and guidelines), **implement the required actions and adopt suitable safety measures**.

Ambient conditions

NOTICE

To the best of our knowledge the equipment is in compliance with the requirements of the applicable EC-directives and harmonized standards (see ”Declaration of conformity”) with regard to design, type and model. Directive IEC 1010 gives in detail conditions under which the equipment can be operated safely (see also IP degree of protection).

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Adopt suitable measures in case of differences, e. g. using the equipment outdoors, installation in altitudes of more than 1000 m above mean sea level, conductive pollution or bedewing.
Pay attention to the permissible maximum ambient and gas inlet temperatures (see ”Technical data”).

Operating conditions

DANGER

➨ **The pumps have no approval for operation in or for pumping of potentially explosive atmospheres.**

➨ The pumps are **not suitable** to pump
- **unstable substances** and substances which react explosively under **impact** (mechanical stress) and/or when being exposed to **elevated temperatures** without air,
- **self inflammable** substances,
- substances which are **inflammable without air** and
- **explosive substances**.

CAUTION

- The pumps are **not suitable** for pumping substances which may form **deposits** inside the pump. Deposits and condensate in the pump may lead to increased temperatures even to the point of excessing the maximum permitted temperatures!

- If there is a danger of formation of **deposits** in the pump chamber (check inlet and outlet of the pump), inspect the pump chambers regularly and clean if necessary.

- The pumps are **not suitable** for pumping dust and have **no approval** for operation below ground.

NOTICE

If pumping **different substances**, it is recommended to purge the pump with air or inert gas prior to changing the pumped media in order to pump out residues and to avoid reactions of the pumped substances with each other and with the pump materials.
Take into consideration interactions and chemical reactions of the pumped media. Ensure that the materials of the wetted parts are compatible with the pumped substances, see section ”Technical data”.

Safety during operation

DANGER

➨ Adopt suitable measures to prevent the release of dangerous, toxic, explosive, corrosive, noxious or polluting fluids, vapours and gases. In case install an appropriate collecting and disposal system and take protective action for pump and environment.

➨ Prevent any part of the human body from coming into contact with vacuum.

➨ The user must take suitable precautions to prevent any formation of explosive mixtures in the expansion chamber or at the outlet. In case of e.g. a diaphragm crack, mechanically generated sparks, hot surfaces or static electricity may ignite these mixtures. Use inert gas for venting if necessary.
➨ Potentially explosive mixtures at the outlet of the pump have to be drained appropriately, sucked off or diluted with inert gas to non-explosive mixtures.

☞ Pay attention to the symbol ”hot surfaces” on the equipment. Adopt suitable measures to prevent any danger arising from the formation of hot surfaces or electric sparks. Provide a suitable protection against contact if necessary.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

⚠CAUTION

- Comply with applicable regulations when disposing of chemicals. Take into consideration that chemicals may be polluted.
  Take adequate precautions to protect people from the effects of dangerous substances (chemicals, thermal decomposition products of fluoroelastomers), wear appropriate safety-clothing and safety glasses.

- Use only **genuine spare parts and accessories.** Otherwise safety and performance of the equipment as well as the electromagnetic compatibility of the equipment might be reduced.
  Possibly the CE mark or the C/US conformity becomes void if not using genuine spare parts.

- Failure of the pump (e.g. due to power failure) or of connected components, parts of the supply or change of parameters must not lead to a critical dangerous situation under any circumstances. In case of diaphragm cracks or leaks in the manifold pumped substances might be released into the environment or into the pump housing or motor. Comply especially with notes on operation and use and maintenance.

- Due to the residual **leak rate of the equipment**, there might be an exchange of gas, albeit extremely slight, between the environment and the vacuum system.
  Adopt suitable measures to prevent contamination of the pumped substances or the environment.

NOTICE

Do not start the pump if the pressure difference between inlet and outlet port exceeds 1.1 bar at maximum.
Prevent the backpressure of gases and the backflow of condensates.
Never suck liquids or dust into the pump.

Provide appropriate protective measures (i.e. precautions which allow for the requirements of the respective application) even for the case of failure and **malfunction**.

Pumps with 115 V motor, 230 V motor and dual-voltage motor:
In case of overload the motor is shut down by a **self-hold thermal cutout** in the winding.
Attention: Reset possible only manually. Switch off the pump or isolate the equipment from mains. Identify and eliminate the cause of failure. Wait approx. five minutes before restarting the pump.

Attention: In case of **supply voltage below 100V**, the lock of the cutout might be restricted and the pump might restart on its own after sufficient cooling down. Take suitable precautions, if an automatic restart of the pump may lead to a critical dangerous situation.

Pumps with 24 V DC voltage:
The motor is protected by a **temperature sensor at the circuit board:** Current limitation if the temperature at the circuit board is higher than 70°C, switching off the pump if the temperature is higher than 85°C. In case of blockade of the motor (after 10 attempts to start-up) the pump is switched off.
If the pump is switched off due to safety measures, manual reset is necessary. Isolate the pump from mains. Eliminate the cause of failure before restarting the pump.

Maintenance and repair

Wear parts have to be replaced regularly. In case of normal wear the lifetime of the diaphragms and valves is > 10000 operating hours. Bearings have a typical durability of 40000 h. Motor capacitors have a typical durability in the range of 10000 to 40000 h depending strongly on the operation conditions like ambient temperature, humidity or load.

⚠CAUTION

- Check every capacitor regularly by measuring its capacity and estimating its operation time. Exchange old capacitors early enough to prevent a failure. If an overaged motor capacitor fails it might get hot and even melt and may cause a flame to form which could be **dangerous for persons and equipment in the vicinity**. The capacitors have to be replaced by an electrician.

➨ **Isolate equipment from mains** and **wait two minutes** before starting maintenance to allow the capacitors to discharge.

⚠WARNING

☞ **Ensure that the pump cannot be operated accidentally. Never operate the pump if covers or other parts of the pump are disassembled. Never operate a defective or damaged pump.**

☞ **Attention**: The pump might be contaminated with process chemicals which have been pumped during operation. Ensure that the pump is decontaminated before maintenance and take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred.

⚠CAUTION

- Before starting maintenance vent the pump, isolate the pump and other components from the vacuum system. Allow sufficient cooling of the pump. Drain condensate, if applicable.

Ensure that **maintenance** is done only by suitably trained and supervised technicians. Ensure that the maintenance technician is familiar with the safety procedures which relate to the products processed by the pumping system.
In order to comply with law (occupational, health and safety regulations, safety at work law and regulations for environmental protection) vacuum pumps, components and measuring instruments returned to the manufacturer can be repaired only when certain procedures (see section **"Notes on return to the factory"**) are followed.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Technical data

Type		MD 1	MD 1 VARIO-SP
Maximum pumping speed (ISO 21360)	m^3/h	1.2 / 1.4*	1.7 (2200 rpm)
Ultimate vacuum (absolute)	mbar	1.5	< 1.0 (700 rpm)
Maximum permissible outlet pressure (absolute)	bar	1.1	
Maximum pressure difference between inlet and outlet	bar	1.1	
Permissible ambient temperature storage / operation	°C	-10 to +60 / +10 to +40	
Permissible relative atmospheric moisture during operation (no condensation)	%	30 to 85	
Rated motor power	kW	0.08	0.064
No-load speed	min^{-1}	1500 / 1800*	350 - 2200
Maximum permissible range of supply voltage (±10%) **Attention: Observe specifications of rating plate!**		100-115 V~ 50/60 Hz 200-230 V~ 50/60 Hz 115 V~ 60 Hz	24 V DC
Maximum rated current at: 100-115 V~ 50/60 Hz 200-230 V~ 50/60 Hz 115 V~ 60 Hz 24 V DC	 A A A A	 1.6 / 1.7 0.8 / 0.85 1.7 -	 - - - 7
Motor protection		thermal cutout, manual reset**; MD 1 C/US: additional fuse 2.5 AT	temperature sensor on the pcb (current limitation)
Degree of protection IEC 529		IP 44	IP 20
Inlet		hose nozzle DN 6 mm G 1/8"	
Outlet		silencer G 1/8“	
Dimensions L x W x H approx. MD 1 C/US	mm mm	303 x 143 x 216 313 x 143 x 216	223 x 143 x 163 -
Dimensions L x W x H w/o handle approx. MD 1 C/US	mm mm	303 x 143 x 163 313 x 143 x 163	- -
Weight approx. MD 1 C/US	kg kg	6.5 6.7	4.1 -

* at 50/60 Hz

** In case of supply voltage below 100V, the lock of the cutout might be restricted.

We reserve the right for technical modification without prior notice!

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Gas inlet temperatures

Operating condition	Inlet pressure	Permitted range of gas temperatures at inlet
Continuous operation	> 100 mbar (high gas load)	+10°C to +40°C
Continuous operation	< 100 mbar (low gas load)	0°C to +60°C
Short-time (< 5 minutes)	< 100 mbar (low gas load)	-10°C to +80°C

Wetted parts

Components	Wetted materials
Housing cover	Aluminium alloy (AlMgSi)
Head cover	Aluminium alloy (AlMgSi)
Diaphragm clamping disc	Aluminium alloy (AlMgSi)
Diaphragm	PTFE
Valves	FPM
Inlet (hose nozzle)	Aluminium anodized
Outlet (silencer)	Aluminium / silicone caoutchouc
Fittings	Aluminium anodized
Tubing	PE

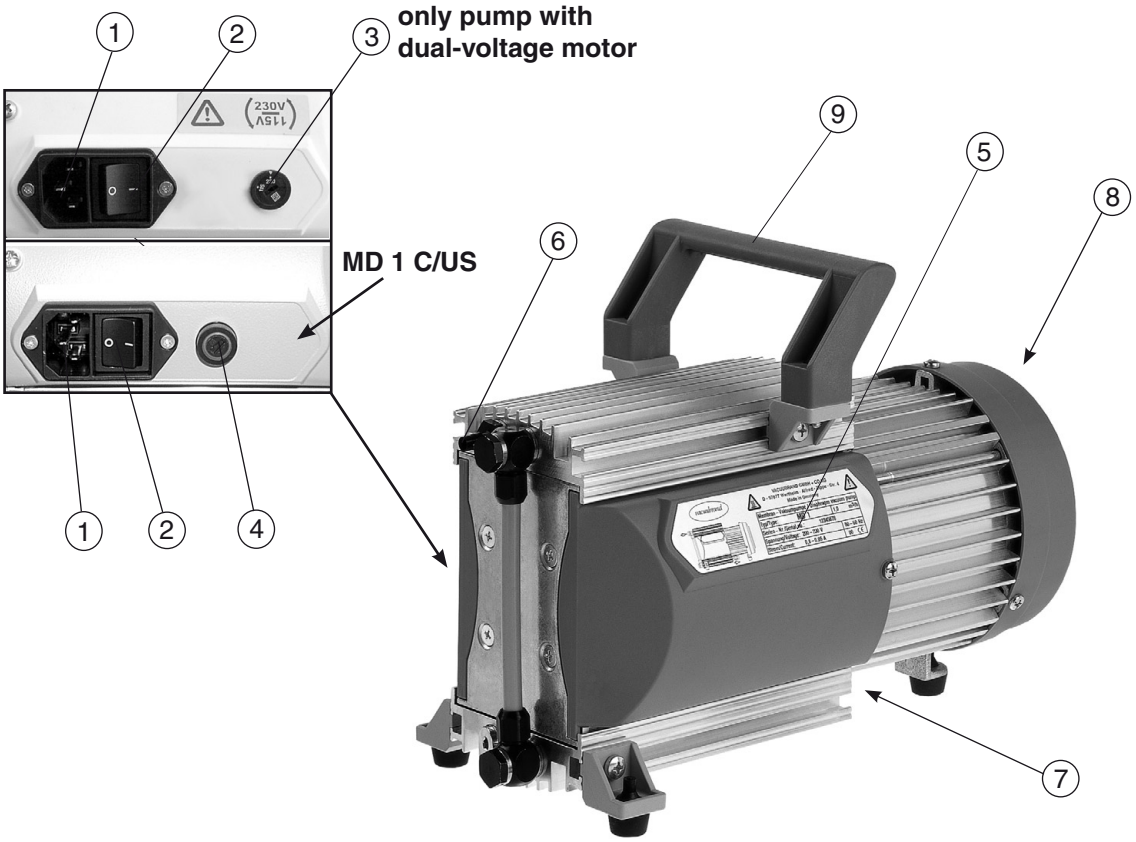
Pump parts

Position	Component
1	Mains connection
2	ON/OFF switch
3	Voltage changeover switch
4	Fuse carrier
5	Pump rating plate
6	Inlet

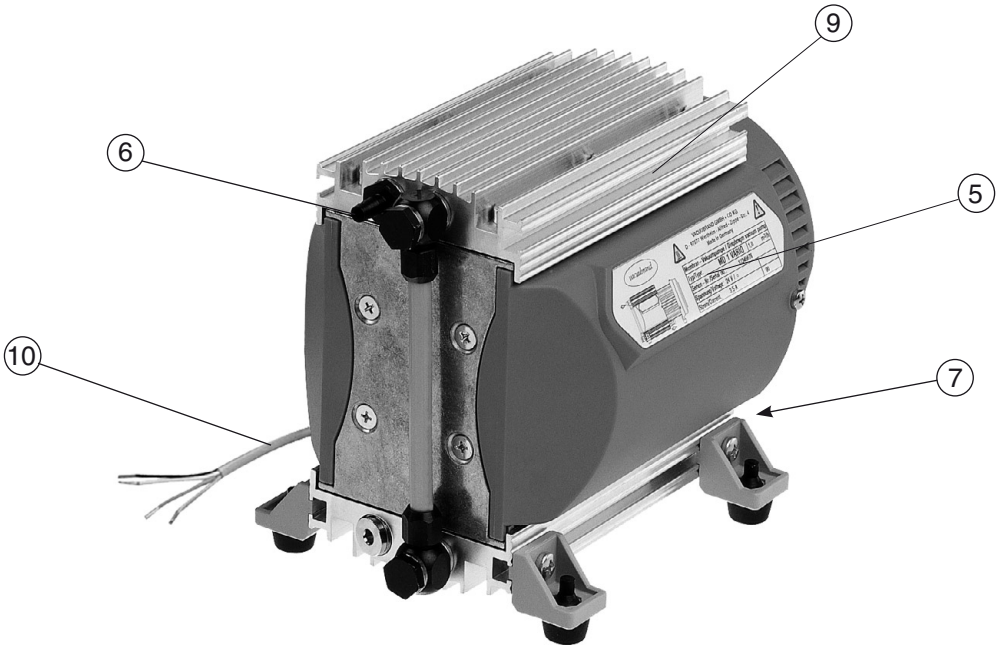
Position	Component
7	Outlet
8	Fan
9	Recessed grip / handle (removable)
10	Control line

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

MD 1



MD 1 VARIO-SP



Ensure sufficient venting of the pump!

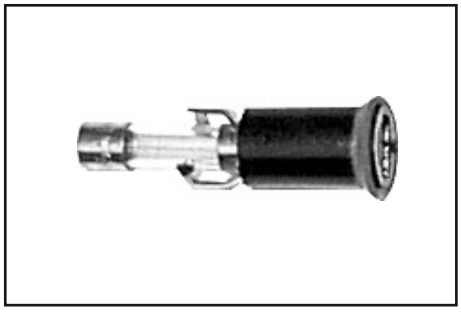
Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Only pumps with dual-voltage motor!
Voltage selection switch:
Change the selection at the voltage changeover switch only if the pump is separated from mains.
Use a screw driver to adjust the supply voltage on the **voltage changeover switch**:

”115” corresponds to 100-120V and
”230” corresponds to 200-230V.

Pumps with dual-voltage motor:
☞ **Check that the voltage changeover switch is correctly positioned.**
Attention: If the voltage is not correctly selected, the motor can be damaged if the pump is switched on. Change the selection at the voltage changeover switch only if the pump is separated from mains.

Replacing the motor fuse (only MD 1 C/US)



- Unscrew the fuse carrier at the side of the pump using a screw driver.
- Replace the defective fuse by a fuse of the same type (2.5 AT) and reassemble fuse carrier with fuse to the pump.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Controlling the MD 1 VARIO-SP

Connecting the control line:

1: +24V
2: GND (24V)
3: Signal (depending on selection of the signal input:
0V - 10V for voltage input, 5V - max. 24V for PWM)
4: GND signal

Setting the motor speed externally via PWM *(factory-set)*:

PWM (5V - max. 24V), frame frequency: >100 Hz, <1.5 kHz
Minimum motor speed 350 rpm: at 25% PWM
Maximum motor speed 2200 rpm: at 75% PWM

e.g., at a frame frequency of 100 Hz and 25% PWM: pulse-width 2.5 ms

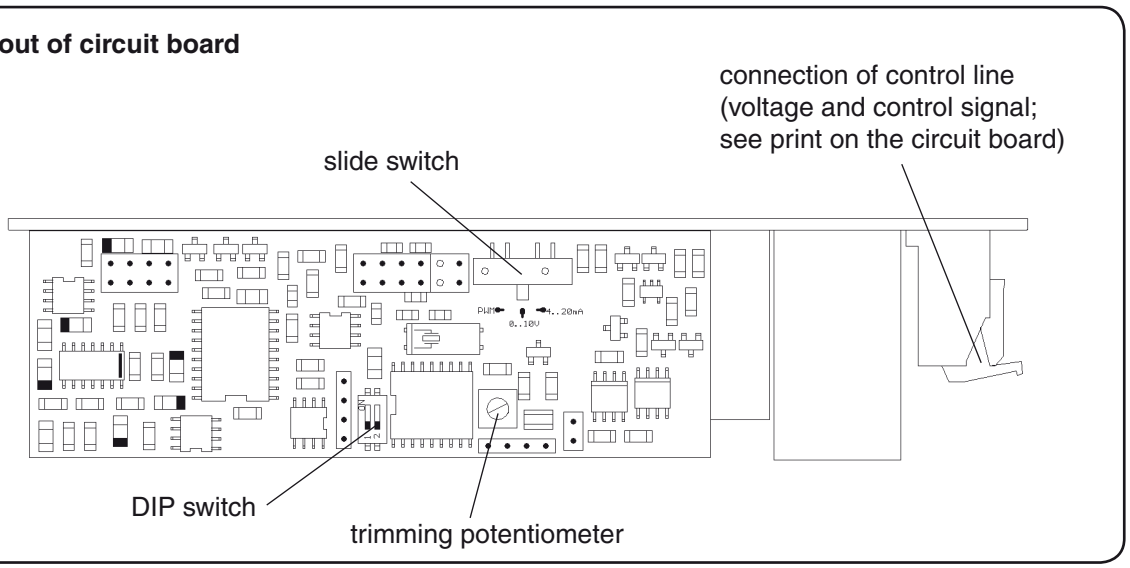
Factory-set, the pump is designed for operation with a control signal; i.e. without a control signal, the pump does not start!

To operate the pump without a control signal, change the settings on the circuit board (see below)!

Selecting the control signal input:

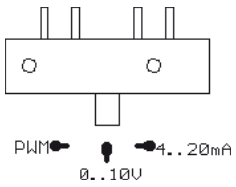
To select the control signal input, use the slide switch, the DIP switch and/or the trimming potentiometer on the circuit board. For that purpose, loosen the screw fixing the cover with the cable duct. Slide the cover carefully, and only as far as necessary, aside.

Layout of circuit board



Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Settings at the slide switch



- **"PWM" (factory-set)** or
- voltage input (0 .... 10 V)

Note: Controlling of the motor speed via current input (4 .... 20 mA) is available on request.

Settings at the DIP switch

1	2	
on	on	setting the motor speed internally (via trimming potentiometer), programming mode
off	on	**setting the motor speed externally and digitally via PWM (factory-set)**
off	off	analogue and external setting of the motor speed (voltage 0..... 10V)

External setting of the motor speed via voltage input:

Voltage input: analogue 0V .... 10V (max. 20V !)
0V to < 2.5V: No operation, stand still of the motor
2.5V to 7.5V: Linear increase of the motor speed (350 rpm to 2200 rpm)
7.5V to 10V: Maximum motor speed (2200 rpm)

Internal setting of the motor speed via trimming potentiometer:

☞ Supply the pump with the required supply voltage of 24V DC.
☞ **For internal setting of the motor speed, set the DIP switch to positions "on / on" (programming mode).**

Adjusting the motor speed with the trimming potentiometer:
Turning the trimming potentiometer to the right: decreasing motor speed (minimum 350 rpm);
Turning the trimming potentiometer to the left: increasing motor speed (maximum 2200 rpm).
Maximum number of motor speed settings: 50.

☞ In case, separate pump from voltage supply.

Notes regarding the motor speed

Pumping at **high motor speed** increases the **pumping speed** of the pump. Ensure sufficient cooling of the pump!
Pumping at **low motor speed** increases the **ultimate vacuum** of the pump and also the lifetime of diaphragms and valves!

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Use and operation

Installing in a vacuum system

⚠CAUTION

- Connection lines at the pump inlet have to be gas tight. Particles and dust must not be aspirated, the user has to provide appropriate filters if necessary. The user must ensure their suitability concerning gas flow, chemical resistance and safeness against clogging prior to use.
- Connect an exhaust line gas tight at the pump outlet if necessary. Always dispose of exhaust gases appropriately (e.g. into a fume hood). If there is risk of release of dangerous or polluting fluids, install an appropriate system to catch and dispose of those fluids.

- Reduce the transmission of vibration and prevent mechanical load due to rigid pipelines. Insert elastic hoses or flexible elements as couplings between the pump and rigid pipes. **Attention:** Flexible elements tend to shrink when evacuated.
- The gas outlet must never be blocked. The exhaust line has always to be free (pressureless) to ensure an unimpeded discharge of gas.

- A power failure may cause accidental ventilation of the pump. In case this constitutes a potential source of danger, take appropriate safety measures.
- Make sure ventilation is adequate especially if the pump is installed in a housing or if the ambient temperature is elevated. Provide external ventilation if necessary. Keep a distance of minimum 20 cm between fan and ambient parts.

- Check that mains voltage and current conform with the equipment (see rating plate).
  Pump with dual-voltage motor: Check that the voltage changeover switch is positioned correctly.
  Attention: If the pump is switched on with wrong voltage selection, the motor may be damaged!
  Before starting the pump, check that the voltage changeover switch is correctly positioned.
  Change the selection at the voltage changeover switch only if the pump is separated from mains.

Voltage changeover switch:
Change the selection at the voltage changeover switch only if the pump is separated from mains.
Use a screw driver to adjust the supply voltage on the **voltage changeover switch**:
”115” corresponds to 90-126 V and
”230” corresponds to 180-253 V.

NOTICE

Avoid throttling losses by using connecting pipes with large diameter and by keeping them as short as possible.
Install outlet pipelines always falling to avoid backflow of condensate towards the pump.
Use of a suitable valve to isolate the pump from the vacuum system is recommended to allow the pump to warm up before pumping condensable vapours or to clean the pump before it is switched off.

When assembling, ensure **vacuum-tightness**. After assembly, check the whole system for leaks.
Secure hose connections at the pump appropriately against accidental detaching.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

During operation

⚠CAUTION

- **Maximum ambient temperature**: 40 °C
- Make sure ventilation is adequate especially if the pump is installed in a housing or if the ambient temperature is elevated.
- **Potentially dangerous gases or vapours** at the outlet of the pump have to be drained and disposed of appropriately.
- Due to the high compression ratio of the pumps, the pressure at the outlet port might get higher than the maximally permitted pressure compatible with the **mechanical stability** of the system. Ensure that the pump outlet is not blocked or restricted.

NOTICE

If the pump is installed in altitudes of more than 1000 m above mean sea level check compatibility with applicable safety requirements, especially IEC 60034 (motor might overheat due to insufficient cooling).
Do not start the pump if the **pressure difference between inlet and outlet ports** exceeds **max. 1.1 bar**. Attempts to start the pump at higher difference may cause blockade and damage of the motor.
Check compatibility with **maximally permitted pressure** at outlet and **maximum pressure difference** between inlet and outlet ports.

Prevent internal condensation, transfer of liquids or dust. The diaphragms and valves will be damaged, if liquids are pumped in significant amounts.
Check the pump regularly for external soiling and deposits, clean if necessary to avoid an increase of the pump‘s operating temperature.

Pumps with 115V motor, 230V motor and dual-voltage motor:
In case of excess temperature, the motor is shut down by a **thermal cutout** in the winding.
Attention: Reset possible only manually. Switch off the pump or isolate the equipment from mains. Determine and eliminate the cause of failure. Wait approx. five minutes before restarting the pump.
Attention: In case of **supply voltage below 100V**, the lock of the cutout might be restricted and the pump might restart on its own after sufficient cooling down. Take suitable precautions, if an automatic restart of the pump might lead to a dangerous situation.

Pumps with 24 V DC voltage: The motor is protected by a **temperature sensor at the circuit board** (current limitation if the temperature at the circuit board is higher than 70°C)

A warm up period (approx. 15 min.) is required to ensure that the rated ultimate vacuum and pumping speed are attained. Avoid high heat supply (e. g. due to hot process gases).

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Shutdown

NOTICE

Short-term:
Has the pump been exposed to condensate?
Allow the pump to continue to run at atmospheric pressure for a few minutes.
Has the pump been exposed to media which may damage the pump materials or form **deposits**?
Check and clean pump heads if necessary.

Long-term:
Take measures as described in section short-term shutdown.
Separate pump from the apparatus.
Close inlet and outlet port (e. g. with transport caps).
Store the pump in dry conditions.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Troubleshooting

Fault	Possible cause	Remedy
❑ Pump does not start or stops immediately.	➔ Supply voltage too low or power supply failure?	☞ Check supply voltage. Check fuse.
	➔ **Only VARIO-SP version**: Control signal for motor speed is missing?	☞ Check control signal.
	➔ Pressure in outlet pipeline too high?	☞ Remove blockade in line, open valve.
	➔ Motor overloaded?	☞ Allow motor to cool down, identify and eliminate cause of failure. Manual reset is necessary. Switch off pump or unplug mains.
	➔ **Only C/US version**: Motor fuse blown?	☞ Check and replace motor fuse. Identify and eliminate cause of failure.
❑ Pump does not achieve its ultimate vacuum or usual pumping speed.	➔ Centring ring at small flange connection not correctly positioned or leak in the pipeline or vacuum system?	☞ Check pump directly - connect vacuum gauge directly at pump inlet - then check connection, pipeline and vacuum system if necessary.
	➔ Long, narrow line?	☞ Use lines with larger diameter, length as short as possible.
	➔ Pump has been exposed to condensate?	☞ Allow pump to run for some minutes with atmospheric pressure at the inlet.
	➔ Deposits have been formed inside the pump?	☞ Clean and inspect the pump heads.
	➔ Diaphragms or valves damaged?	☞ Replace diaphragms and/or valves.
	➔ Outgassing substances or vapour generated in the process?	☞ Check process parameters.
	➔ **Only VARIO-SP version**: Pump temperature too high (motor speed reduced)?	☞ Ensure sufficient cooling of the pump or reduce inlet pressure.
❑ Pump too noisy.	➔ Atmospheric or high pressure at the pump inlet?	☞ Connect hose or silencer to pump outlet.
	➔ Diaphragm crack or diaphragm clamping disc loose?	☞ Perform maintenance.
	➔ Other than above mentioned causes?	☞ Contact local distributor.
❑ Pump seized.		☞ Contact local distributor.

A **service manual** with exploded view drawings, spare part lists and directions for repair is available on request (only in German or English).
☞ The service manual is for trained service people.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Replacing diaphragms and valves

All bearings are encapsulated and are filled with long-life lubricant. Under normal operating conditions, the pump is maintenance free. The valves and diaphragms as well as the motor capacitors are wear parts. If the rated ultimate vacuum is no longer achieved or in case of increased noise level, the pump interior, the diaphragms and the valves must be cleaned and the diaphragms and valves must be checked for cracks or other damage. Check every capacitor regularly by measuring its capacity and estimating its operation time. Exchange old capacitors early enough to prevent a failure. The capacitors have to be replaced by an electrician. Depending on individual cases it may be efficient to check and clean the pump heads on a regular basis. In case of normal wear the lifetime of the diaphragms and valves is > 10000 operating hours.

- Prevent internal condensation, transfer of liquids or dust. The diaphragm and valves will be damaged, if liquids are pumped in significant amount.

If the pump is exposed to corrosive media or in case of deposits, maintenance should be carried out frequently.

- Regular maintenance will improve the lifetime of the pump and also protect both man and environment.

Ensure that maintenance is done only by suitable trained and supervised technicians.

⚠WARNING

☞ Ensure that the pump cannot be operated accidentally. **Never operate the pump if covers or other parts of the pump are disassembled. Never operate a defective or damaged pump.**

☞ **Before starting maintenance** isolate the pump from the electrical supply and wait **two minutes** after isolating the equipment from mains to allow the capacitors to discharge. Avoid the release of pollutants. Allow sufficient cooling of the pump before starting maintenance.

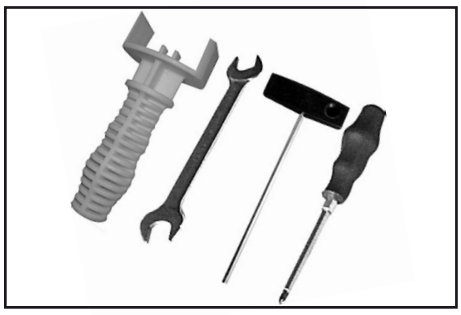
⚠CAUTION

- Attention: The pump might be contaminated with the process chemicals that have been pumped during operation. Ensure that the pump is decontaminated before maintenance and take adequate precautions to protect people from the effects of dangerous substances if contamination has occurred. Ensure that the maintenance technician is familiar with the safety procedures which relate to the products processed by the pumping system.
- Wear appropriate safety-clothing when you come into contact with contaminated components. Avoid the release of pollutants.

NOTICE

Before starting maintenance vent the pump and isolate it from the vacuum system and the electrical supply. Avoid the release of pollutants. Allow sufficient cooling of the pump.

Set of seals MD 1 (4 diaphragms, 8 valves, diaphragm key) ..... cat. no. **696824**



Tools required (metric):

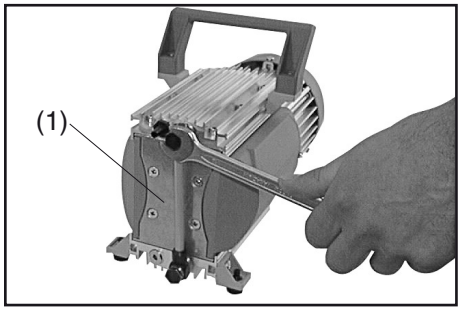
- Diaphragm key SW 46
- Open-ended wrench w/f 15 / 16
- Hex key size 4
- Phillips screw driver size 2

☞ **Please read section ”Replacing diaphragms and valves” completely before starting maintenance.**

Partially the pictures show pumps in other versions. This doesn´t influence replacing diaphragms and valves of the pump.

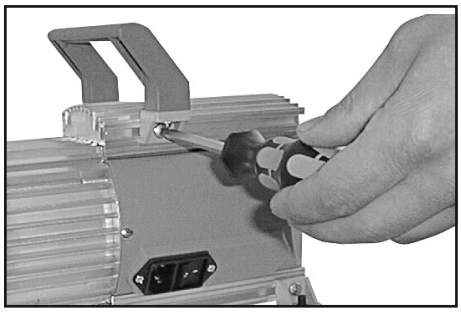
Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Cleaning and inspecting the pump heads

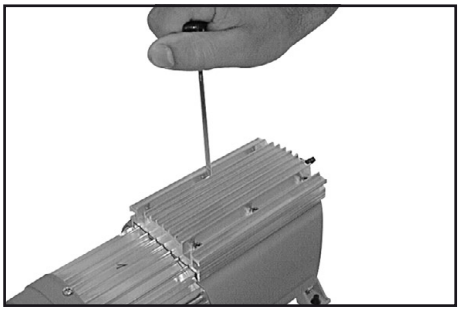


➨ Use an open-ended wrench w/f 15 to loosen the fitting at the pump head and remove fitting together with connecting hose.

Attention: Do not remove the housing bearing flange (1).

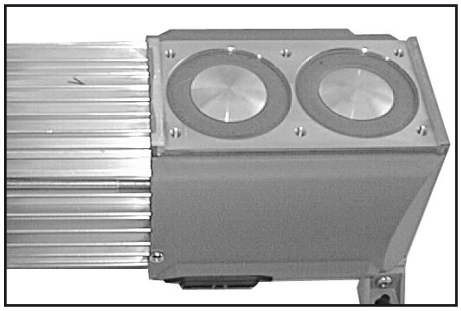


➨ Loosen the two screws (use Phillips screw driver) at the handle and remove handle.



➨ Use a hex key to remove the six socket head screws from the pump head and remove the upper housing (housing cover and head cover).

☞ Never remove parts by using a spiky or sharp-edged tool (e. g. screw driver), we recommend to use a rubber mallet or compressed air (to be blown carefully into port).

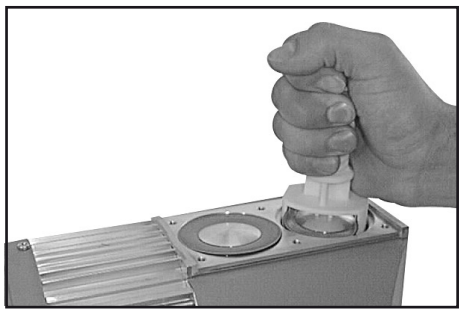


➨ Remove head covers from housing cover and check valves. Note position of valves and remove.

☞ Replace valves if necessary.
Use petroleum ether or industrial solvent to remove deposits. Do not inhale.

☞ Check diaphragm for damage and replace if necessary.

Replacing the diaphragm



➨ Lift diaphragm carefully.

➨ Apply pressure to the clamping disc beside the diaphragm to bring connecting rod into upper turning point position if necessary.

☞ Never use a spiky or sharp-edged tool to lift the diaphragm.

➨ Use diaphragm key to grip under the diaphragm to the diaphragm support disc.

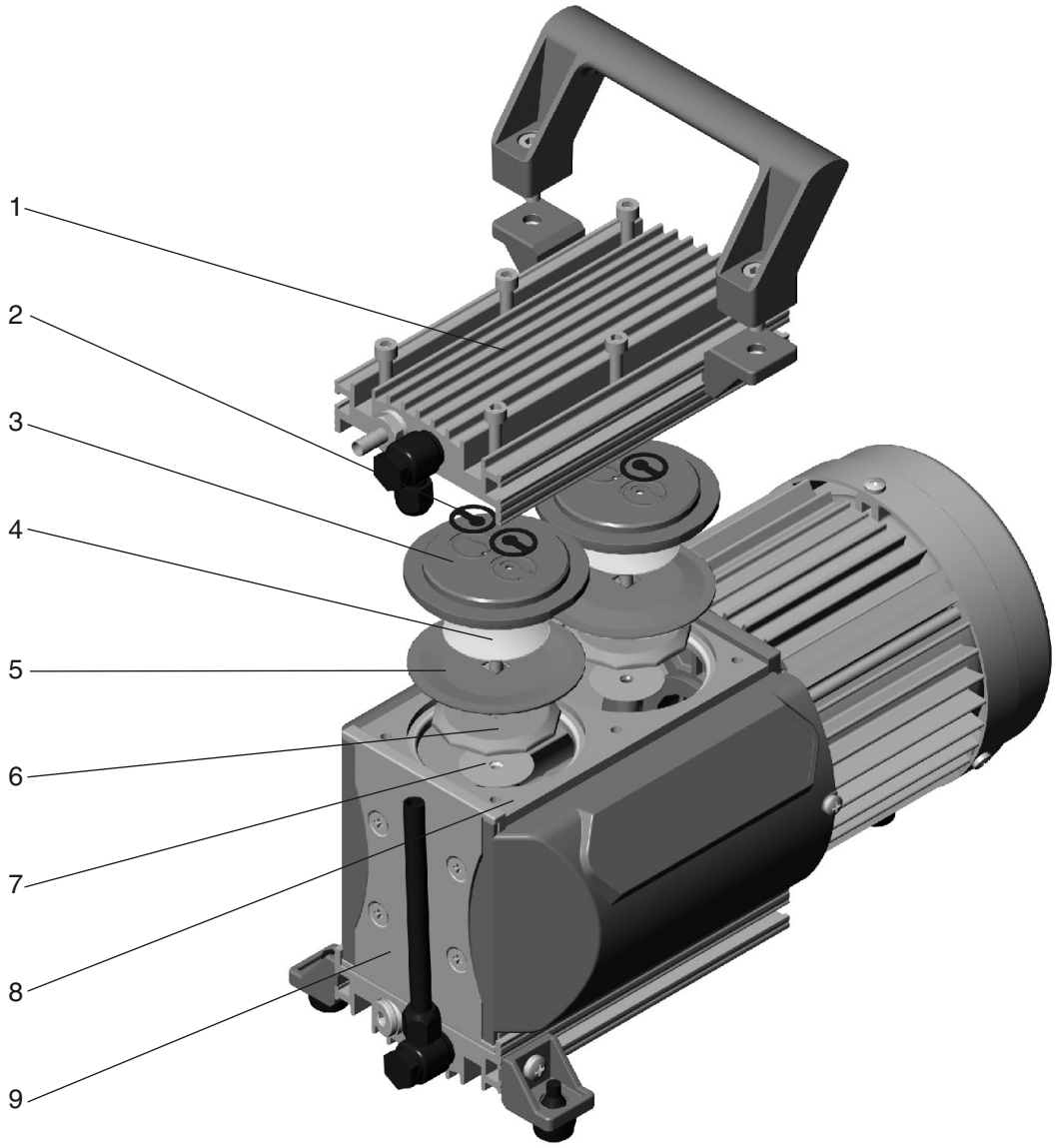
➨ Apply pressure to the diaphragm clamping disc to bring the diaphragm into lower turning point position. Press diaphragm key against diaphragm clamping disc and unscrew diaphragm support disc with diaphragm.

☞ If the old diaphragm is difficult to separate from the support disc, immerse assembly in naphtha or petroleum ether. Do not inhale!

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

☞ Check for washers under clamping disc. Do not mix the washers from the different heads. Make sure that the original number is reassembled at the individual pump head.

View of the disassembled pump head parts

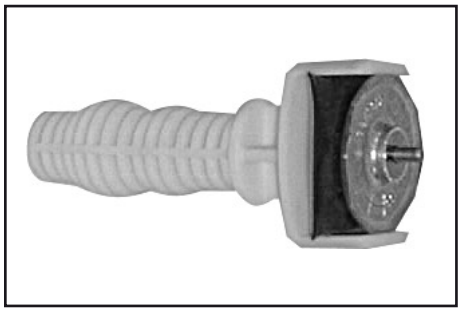


1: housing cover
2: valves
3: head cover
4: diaphragm clamping disc with connecting screw
5: diaphragm
6: diaphragm support disc
7: rod and washers
8: housing
9: housing bearing flange

➨ Position new diaphragm between diaphragm clamping disc with square head screw and diaphragm support disc.

☞ **Note:** Position diaphragm with light PTFE side to diaphragm clamping disc (to pump chamber).

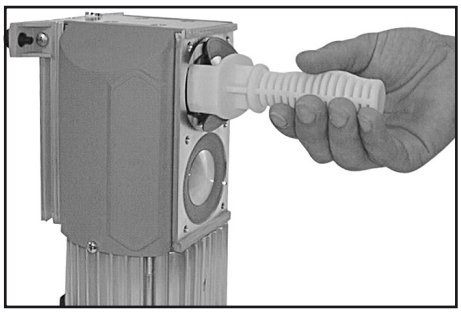
Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008



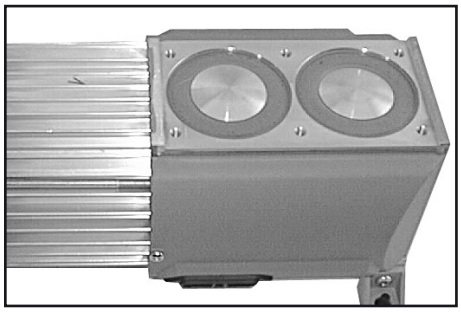
➨ Lift diaphragm at the side and position carefully together with diaphragm clamping disc and diaphragm support disc in the diaphragm key.
☞ Avoid damage of the diaphragm: Do not crack diaphragm in a way that white lines at the diaphragm's upper side occur.

➨ Check for washers under clamping disc. Do not mix the washers from the different heads. Make sure that the original number is reassembled at the individual pump head.
☞ Smaller number of washers: The pump will not attain final vacuum. More washers: Clamping disc will hit head cover; noise or even blockage of the pump.

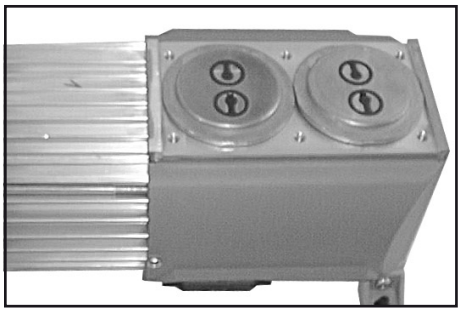
Replacing the valves and assembling the pump heads



☞ Make sure that the square head screw of the diaphragm clamping disc is correctly seated in the guide hole of the diaphragm support disc.
➨ Assemble diaphragm clamping disc, diaphragm and diaphragm support disc to connecting rod.
☞ Position washers between diaphragm support disc and rod.



➨ Bring diaphragm into a position in which diaphragm is in contact with housing and centred with respect to bore.

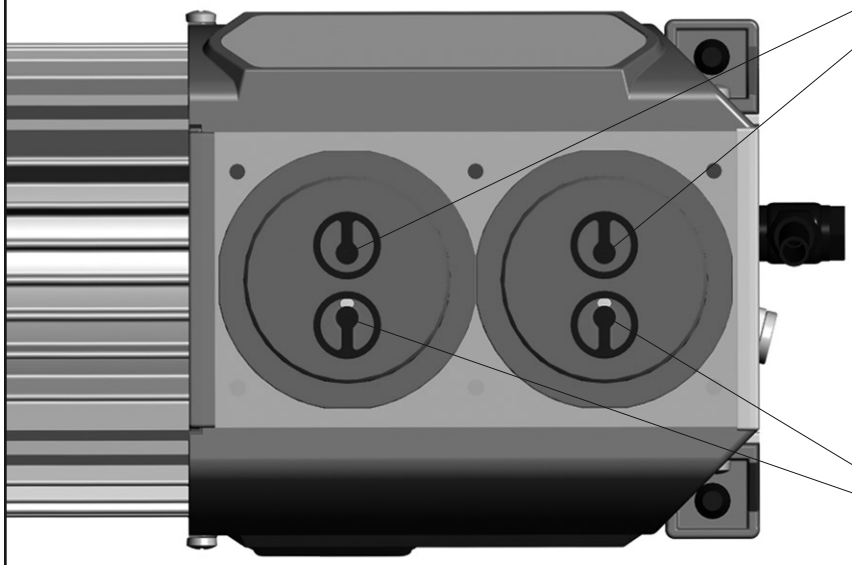


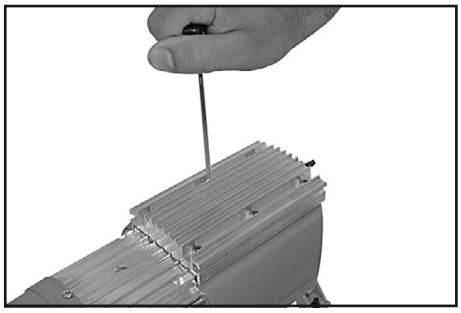
➨ Assemble head cover and valves.
☞ Check for correct position (see fig. below).

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

It is essential to mind the position and orientation of the head covers and the valves!

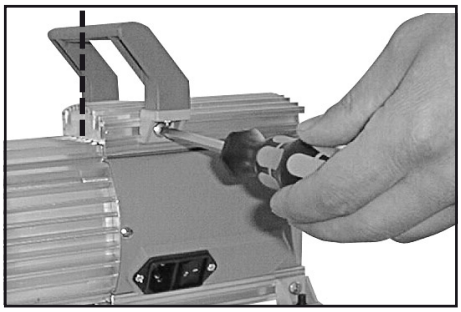
Scheme of pump head with head covers and valves





- ➨ Position housing cover.
- ☞ Move housing cover slightly to make sure that the head covers are correctly positioned.
- ➨ Screw in six socket head screws fixing housing cover crosswise first slightly, then tighten.
- ☞ Do not tighten until head cover is in contact with housing, **max. torque 6 Nm.**

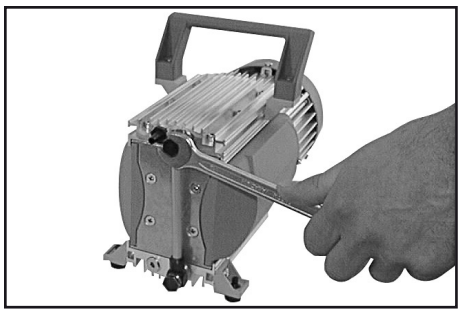
Replace diaphragms and valves similarly on the other side of the pump.



- ➨ Assemble handle with screws and tighten.
- ☞ Check for correct position of the handle over the centre of gravity of the pump. The handle is correctly positioned if the end of the handle is flush with the end of the housing cover.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Assembling the connection hose



➨ Use an open ended wrench w/f15 to reconnect the fitting with the connection hose to the pump head.
☞ Steady with open ended wrench w/f 16 when tightening the hollow bolt.

If the pump does not achieve the ultimate vacuum:

☞ In case the diaphragms and valves have been replaced, a run-in period of several hours is required before the pump achieves its ultimate vacuum.

If the pump does not achieve the ultimate vacuum:
Check hose connection between pump heads and manifolds for leaks. If necessary recheck pump chamber.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Notes on return to the factory

Repair - return - DKD calibration

NOTICE

Safety and health of our staff, laws and regulations regarding the handling of dangerous goods, occupational health and safety regulations and regulations regarding safe disposal of waste require that for all pumps and other products the **"Health and safety clearance form"** must be send to our office duly completed and signed before any equipment is dispatched to our premises.
Fax or post a completed copy of the health and safety clearance form to us in advance. The declaration must arrive before the equipment. Enclose a second completed copy with the product. If the equipment is contaminated you must notify the carrier.
No repair / DKD calibration is possible unless the correctly completed form is returned. Inevitably, there will be a delay in processing the equipment if information is missing or if this procedure is not obeyed.

⚠CAUTION

If the product has come in contact with chemicals, radioactive substances or other substances dangerous to health or environment, the product must be decontaminated **prior to sending it back to the factory.**

- Return the product to us **disassembled and cleaned** and accompanied by a certificate verifying decontamination or
- Contact an industrial cleaning and **decontamination service** directly or
- Authorize us to send the product to an industrial cleaning facility **at your expense.**

To expedite repair and to reduce costs, please enclose a detailed description of the problem and the product´s operating conditions with every product returned for repair.
We submit **quotations** only on request and always at the customer´s expense. If an order is given, the costs incurred are offset from the costs for repair or from the purchase price, if the customer prefers to buy a new product instead of repairing the defective one.

- **If you do not wish a repair on the basis of our quotation, the equipment might be returned to you disassembled and at your charge!**

In many cases, the **components must be cleaned in the factory** prior to repair.
For cleaning we use an environmentally responsible water based process. Unfortunately the combined attack of elevated temperature, cleaning agent, ultrasonic treatment and mechanical stress (from pressurised water) may result in damage to the paint. Please mark in the health and safety clearance form if you wish a **repaint at your expense** just in case such a damage should occur.
We also replace parts due to optical aspects upon your request.

NOTICE

Before returning the equipment ensure that (if applicable):

- Equipment has been cleaned and/or decontaminated.
- All inlet and outlet ports have been sealed.
- Equipment has been properly packed, if necessary, please order an original packaging (costs will be charged), marked as appropriate and the carrier has been notified.
- Ensure that the completed health and safety declaration is enclosed.

We hope for your understanding for these measures, which are beyond our control.

Scrapping and waste disposal:
Dispose of the equipment and any components removed from it safely in accordance with all local and national safety and environmental requirements. Particular care must be taken with components and waste oil which have been contaminated with dangerous substances from the process. Do not incinerate fluoroelastomer seals and O-rings.

- You may authorize us to dispose of the equipment **at your expense.**

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Health and safety clearance form

Declaration concerning safety, potential hazards and safe disposal of waste, e. g. used oil.

Safety and health of our staff, laws and regulations regarding the handling of dangerous goods, occupational health and safety regulations, safety at work laws and regulations regarding safe disposal of waste, e. g. waste oil, require that for all pumps and other products this form must be sent to our office duly completed and signed before any equipment is dispatched to our premises. **Products will not be accepted for any procedure, and handling and repair / DKD calibration will not start before we have received this declaration.**

a) Fax or post a **completed copy of this form** to us in advance. The declaration must arrive before the equipment. **Enclose a second, completed copy with the product.** If the product is contaminated you must notify the carrier (**GGVE, GGVS, RID, ADR**).

b) Inevitably, the repair process will be delayed considerably, if this information is missing or this procedure is not obeyed. We hope for your understanding for these measures which are beyond our control and that you will assist us in expediting the repair procedure.

c) **Make sure that you know all about the substances which have been in contact with the equipment and that all questions have been answered correctly and in detail.**

1. Product (Model): .....

2. Serial No.: .....

3. List of substances in contact with the equipment or reaction products:

3.1 Chemical/substance name, chemical symbol:

a) .....

b) .....

c) .....

d) .....

3.2 Important information and precautions, e. g. danger classification:

a) .....

b) .....

c) .....

d) .....

4. Declaration (please mark as applicable):

❑ **4.1 for non dangerous goods:**

We assure for the returned product that
- neither toxic, corrosive, biologically active, explosive, radioactive nor contamination dangerous in any way has occurred.
- the product is free of dangerous substances.
- the oil or residues of pumped media have been drained.

❑ **4.2 for dangerous goods:**

We assure for the returned product that
- all substances, toxic, corrosive, biologically active, explosive, radioactive or dangerous in any way which have been pumped or been in contact with the product are listed in 3.1, that the information is complete and that we have not withheld any information.
- the product, in accordance with regulations, has been
  ❑ cleaned ❑ decontaminated ❑ sterilized.

5. Way of transport / carrier:

.....

Day of dispatch to VACUUBRAND:

.....

If the paint is damaged, we wish a repaint or a replacement of parts due to optical aspects at our expense (see "Notes on return to the factory"):

❑ yes
❑ no

We declare that the following measures - where applicable - have been taken:
- The oil has been drained from the product. **Important: Dispose of according to national regulations.**
- The interior of the product has been cleaned.
- All inlet and outlet ports of the product have been sealed.
- The product has been properly packed, if necessary, please order an original packaging (costs will be charged), and marked as appropriate.
- The carrier has been informed about the hazardous nature of the goods (if applicable).

We assure VACUUBRAND that we accept liability for any damage caused by providing incomplete or incorrect information and that we shall indemnify VACUUBRAND from any claims as regards damages from third parties.

We are aware that as expressed in § 823 BGB (Public Law Code of Germany) we are directly liable for injuries or damages suffered by third parties, particularly VACUUBRAND employees occupied with handling/repairing the product.

Signature: .....

Name (print): .....

Job title (print): .....

Company´s seal: .....

Date: .....

VACUUBRAND GMBH + CO KG
-Technology for Vacuum Systems-
Alfred-Zippe-Str. 4 - 97877 Wertheim
Tel.: +49 9342 808-0 - Fax: +49 9342 808-450
E-Mail: info@vacuubrand.de - Web: www.vacuubrand.de

© 2008 VACUUBRAND GMBH + CO KG Printed in Germany

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

CE

Konformitätserklärung
Declaration of conformity
Déclaration de conformité

Membranpumpe / Diaphragm pump / Pompe à membrane

MD 1 (230V; 696080, 696081, 696082)
MD 1 VARIO-SP (24V; 696101)

Hiermit erklären wir, daß das oben bezeichnete Gerät in Konzeption und Bauart sowie in der von uns in Verkehr gebrachten Ausführung den grundlegenden Anforderungen der zutreffenden, aufgeführten EU-Richtlinien entspricht.Bei einer mit uns nicht abgestimmten Änderung an dem Gerät verliert diese Erklärung ihre Gültigkeit.
We herewith declare that the product designated above is in compliance with the basic requirements of the applicable EC-directives stated below with regard to design, type and model sold by us. This certificate ceases to be valid if the product is modified without the agreement of the manufacturer.
Par la présente, nous déclarons que le dispositif désigné ci-dessus est conforme aux prescriptions de base des directives EU applicables et indiqués en ci que concerne conception, dessin et modèle vendu par nous-mêmes. Cette déclaration cesse d´être valable si des modifications sont apportées au dispositif sans notre autorisation préalable.

Maschinenrichtlinie (mit Änderungen) / Machine directive (with supplements) / Directive Machines (avec des suppléments)
2006/42/EG
Niederspannungsrichtlinie / Low-Voltage Directive / Directive Basse Tension (nicht anwendbar auf / not applicable to / pas applicable à MD 1 VARIO-SP (696101) 24V)
2006/95/EG
Richtlinie Elektromagnetische Verträglichkeit / Electromagnetic Compatibility Directive / Directive Compatibilité Electromagnétique
2004/108/EG
Angewandte Harmonisierte Normen / Harmonized Standards applied / Normes Harmonisées utilisées
DIN EN 12100-2, DIN EN 61010-1, DIN EN 1012-2, DIN EN 61326-1
Managementsysteme / Management systems / Systèmes de Management
EN ISO 9001, EN ISO 14001 (1997-2006)

Wertheim, 23.09.2008
. . . . . .
Ort, Datum / place, date / lieu, date

. . . . . .
(Dr. F. Gitmans)
Geschäftsführer / Managing director / Gérant

ppa. . . . . .
(Dr. J. Dirscherl)
Technischer Leiter / Technical Director / Directeur technique

VACUUBRAND GMBH + CO KG
-Vakuumtechnik im System-
-Technology for Vacuum Systems-
-Technologie pour système à vide-
Alfred-Zippe-Str. 4 - 97877 Wertheim
Tel.: +49 9342 808-0 - Fax: +49 9342 808-450
E-Mail: info@vacuubrand.de
Web: www.vacuubrand.com

vacuubrand

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Certificate

TÜV

Certificate no. CU 72070564 01

License Holder:
VACUUBRAND GMBH + Co. KG
Alfred-Zippe-Str. 4

97877 Wertheim
Germany

Manufacturing Plant:
VACUUBRAND GMBH + Co. KG
Alfred-Zippe-Str. 4

97877 Wertheim
Germany

Test report no.: USA-RC 02271487 003 **Client Reference:** Jürgen Dirscherl

Tested to: UL 61010A-1:2002 R12.02
CAN/CSA-C22.2 No. 1010.1-92+A2:97

Certified Product: Diaphragm Vacuum Pump for Laboratory Use **License Fee - Units**

Model Designation: M v w x yy z 7
v=E,Z,D,V; w=0.5,1,1.5;
x=C,S,blank; y=A-Z, blank;
z=AK,EK,2AK,AK+EK,AK+EK TE,
AK+EK Peltronik,IK+EK,AK-SY+EK,blank

Rated Voltage: AC 100-120/200-230V, 50/60Hz
Rated Current: 1.7/0.85A
Protection Class: I

Special Remarks: Replaces Certificate CU72032013.

7

Appendix: 1, 1-2

Licensed Test mark:

TÜV Rheinland of North America, Inc. C US

Signatures

Stephan Schmitt
President

Dipl.-Ing. M. Raap
QA Certification Officer

Date of Issue (day/mo/yr)
01/03/2007

TÜV Rheinland of North America, Inc., 12 Commerce Road, Newtown, CT 06470, Tel (203) 426-0888 Fax (203) 426-4009

This certificate is only valid for pumps with C/US mark, see pump rating plate.

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008

Disclaimer: Our technical literature is only intended to inform our customer. The validity of general empirical values and results obtained under test conditions for specific applications depend on a number of factors beyond our control. It is therefore strictly the users´ responsibility to very carefully check the validity of application to their specific requirements. No claims arising from the information provided in this literature will, consequently, be entertained.

VACUUBRAND GMBH + CO KG
-Technology for vacuum systems-
© 2008 VACUUBRAND GMBH + CO KG Printed in Germany

Alfred-Zippe-Str. 4 - 97877 Wertheim
Tel.: +49 9342 808-0 - Fax: +49 9342 808-450
E-Mail: info@vacuubrand.de
Web: www.vacuubrand.com

Documents are only to be used and distributed completely and unchanged. It is strictly the users´ responsibility to check carefully the validity of this document with respect to his product. manual-no.: 999085 / 30/09/2008